MAR 10 2015

Mr. Joseph Benco, P.E.
Vice President
Republic Services
Engineering and Environmental Management
18500 N. Allied Way
Phoenix, Arizona 85054

Dear Mr. Benco:

The U.S. Environmental Protection Agency has reviewed the document titled "Isolation Barrier Alternatives Analysis, West Lake Superfund Site, Bridgeton, Missouri" prepared by Feezor Engineering, Inc. and P. J. Carey & Associates, Auxier and Associates, Inc. and Engineering Management Support, Inc on behalf of Bridgeton Landfill, LLC. The cover letter on the document was dated October 10, 2014.

The EPA is providing comments for the reviewed document and also enclosing comments from the U.S. Army Corps of Engineers, Lambert-St. Louis International Airport, the Missouri Department of Natural Resources and the Missouri Department of Health and Senior Services. All comments should be directly addressed through written correspondence to the EPA. The EPA requests a 30 working day response to all comments, but understands that work plans related to the additional characterization work requested by EPA on January 15, 2015, and Supplemental Feasibility Study may take priority.

If you have questions, please contact me at (913) 551-7611.

Sincerely,

Brad Vann
Remedial Project Manager
Missouri/Kansas Remedial Branch
Superfund Division

Enclosure

cc: Shawn Muenks, MDNR
Paul Rosasco, P.E., EMSI

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General Comments:

1. The concept of a heating event within radiological waste combined with its effect on the radiological conditions, specifically radon flux at the surface is complex. The specific arguments postulated in this document in relation to the heat's effect on the radiologically-impacted material (RIM) and therefore radon flux in Attachment A are well thought out and present plausible scenarios considering an event occurring is a low probability. That said, several specific comments are provided below with regards to Attachment A (Radon Flux Analysis) which warrant consideration and/or addressing in the text of this document.

2. Long-Term O&M and Monitoring. The report did not consider long-term operation and maintenance (O&M) and monitoring associated with the various alternatives. Alternatives 1, 3, and 4 propose the operation of liquid heat extraction systems that may pose several technical challenges (e.g., moving a large amount of liquid, pumping systems, heat exchangers, liquid loss, etc.). Additionally, this heat extraction system, if it is deployed, may require operation for several years, and the durability/longevity of this technology is unclear since we are not familiar with its use at any landfills in the past. Long-term monitoring (e.g., waste temperature, settlement) will also be needed for waste located north of the barrier for Alignment 1, 3, and 4 (as discussed in Section 2.4, Attachment C of the IB Alternatives Report). Alignment 2, although considered infeasible in the report by Feezor, is the only Alignment for which IB-related long long-term monitoring of OU-1 would not be needed. Please review this information and amend the document accordingly.

3. Technical Feasibility. The EPA considers technical feasibility to mean 'able to be constructed, and effective for its intended use.' It would logically follow that there would be little or no purpose in selecting and constructing an IB alternative that could be built, but isn't proven effective in withstanding or containing an SSE. Both Alignment 1 and 3 entail installing a 45 ft to >100 ft deep concrete wall spanning the entire waste depth along the proposed Alignments. The report stated that "although construction of a concrete barrier is considered to be feasible, installation of a non-deformable barrier within a matrix of solid wastes is an application which has not previously been applied or demonstrated in solid waste, so uncertainty as to the success of such a barrier exists." It is unclear how these Alignments were determined to be technically feasible despite a lack of previous documentation or successful demonstration/application. An analysis of the efficacy of Alignment 4, based on referenced literature and documentation, is needed to determine if it is technically feasible. The EPA understands that a limited field pilot effort was conducted for a heat extraction well similar to those proposed in Alignment 4, but the scope and duration of this effort was limited. Alternative 2 is proven and well documented technology; therefore, it is the only demonstrated feasible technology option included in the report. Please review this information and amend the document accordingly.

4. Impact of RIM Excavation and Relocation. Three of the proposed Alignments would entail excavation and relocation of RIM. The estimated amount and impact of RIM excavation and relocation on risk/human health should be quantitatively evaluated for the four proposed Alignments, to the extent possible. Also, the amount of RIM remaining south of the barrier should be estimated for each Alignment, as recent investigations have demonstrated to the EPA that the extent of RIM has not yet been fully delineated. Benefits and drawbacks of

RIM relocation off-site may be important to discuss in these Alignments as well, including any potential special handling, manifesting, and transport needs. Please review this information and amend the document accordingly.

5. No Action Alternative. In general, more data and information are needed to assess the likelihood and impact of SSE migration into OU-1. The following comments are provided that could help to better describe and understand the migration of an SSE.

    a. The report states "*due to the overall thinner nature of the waste materials in Area 1, the effective rate of heat dissipation in the vertical direction will be approximately 25 times greater than the rate observed in the South Quarry area of the Bridgeton Landfill. It is doubtful that any significant pyrolysis would occur at these shallow waste depths due to the lack of insulation. Such behavior would be consistent with observations at other sites that indicated no pyrolysis in waste depths of less than 60 ft.*" It is acknowledged that a shallower waste thickness would likely promote heat dissipation. The basis of the magnitude (25 times) of increase in heat dissipation could not be assessed due lack of details presented in the report. Similarly, more details on "observations at other sites" made in the report are needed to assess the conclusion pertaining to the improbability of pyrolysis in waste depths of less than 60 ft. We note that elevated temperatures (greater than 200 °F) have been observed at waste depths as shallow as 40 ft. We reference data from TMP-7R in the Bridgeton South Quarry over its operational lifetime (ending April 2014) that contradict this statement and merits revision.
    b. The presence of large soil berm in the North Quarry should not be relied upon in any design documents until its presence and details (e.g., dimensions and depth location) are confirmed.
    c. The report states that "*review of the temperature profiles from temperature monitoring probes indicate that in the northern part of the South Quarry, the heat generating material occurs at elevations of greater than or equal to approximately 360 to 380 ft above mean sea level (amsl)... The occurrence of heat generating material at elevation of 360 to 380 ft amsl may reflect the limit of the depth of reactive waste materials or may reflect thermal constraints associated with the configuration of the South Quarry (i.e. dissipation of heat through the bottom and sides of the quarry wall which control the vertical position of the pyrolysis).*"
    We agree that heat dissipation and/or absence of reactive waste below 360-380 ft amsl may contribute to a decline in waste temperature below these elevations. However, it is possible that the presence of water/leachate may also have an influence on the temperature of waste below these elevations. The leachate level at LCS-1D, which is located in northern part of the South Quarry has ranged from 390.22 ft to 394.22 ft amsl since July 1, 2014. This corresponds to a liquid height of 138-142 ft above the quarry bottom. The impact of the presence of leachate on lateral heat migration should be evaluated and considered.
    d. A review of the calculations presented in Appendix A suggests that the SSE would

result in a temporary increase in radon emissions by 60 pCi m^{-2} s^{-1} (associated with thermal expansion of gases present in the pore space of OU-1 waste) above the estimated existing level of 13.5 pCi m^{-2} s^{-1}. Presumably this would result in total radon emissions of 73.5 pCi $m^{-2}s^{-1}$ for a portion of OU-1 (approximately a 75 m^2 area). Although the average emission from OU-1 are estimated to be less than the NESHAP threshold of 20 pCi $m^{-2}s^{-1}$, the potential for, and impact of, a localized and temporary spike in radon emissions should be further evaluated.

e. The impact assessment of the SSE migrating into OU-1 was limited to the evaluation of the impact due to an increased emission of radon. The presence of RIM in OU-1 may limit the SSE remedial options in the event an SSE migrates into OU-1. Consideration of the potential remedial options, and the associated impacts of these options, should be taken into account for a more comprehensive assessment of impacts of the "No Action Alternative."

f. Section 3.0 (Page 5, 2nd Paragraph). Additional information on the thermal modeling described in this section would be helpful to assess the potential of SSE migration into OU-1.

g. Section 3.0 (Page 5, 2nd Paragraph). The lack of tracking of material addition (e.g., for grading purposes) in the South Quarry cell and Neck area complicate settlement monitoring. Providing this detail in future settlement monitoring would allow for a more accurate portrayal of site conditions.

h. Section 3.4 (Page 6, 2nd Paragraph) (and other points throughout the document), it is stated that "No Action" alternative does not pose any potential for odor emission. We suggest that this be clarified since odor emissions have occurred and been well-documented at the site for more than a year. The "No Action" alternative would likely result in similar odors that are currently emanating from the South Quarry if the SSE were to migrate into the North Quarry and beyond, and should be discussed.

i. Section 3.6.1 (Page 7, 1st Paragraph) states that "Monitoring of waste and landfill gas temperatures, landfill gas quality (e.g., carbon monoxide and hydrogen), and surface settlement all indicate that the SSE occurs only in the Bridgeton South Quarry area..." To our knowledge, no routine surveying has been conducted in the Bridgeton North Quarry cell as has been conducted in the South Quarry and Neck area, so it is not clear how a statement can be made that a lack of settlement in the North Quarry cell is evidence that no SSE is occurring there.

j. Section 3.6.1 (Page 8, 1st Paragraph). Including a review of the referenced Phase 1 Investigation of potential IB alignments would be helpful in comparing the stated conditions in this report to those described in the referenced report.

k. Section 3.6.1 (Page 8, 1st Paragraph). Information presented in this paragraph suggests that the extent of RIM has been defined, but past sampling did not identify a complete delineation of RIM. Additionally, the discussion in the report indicates that a limited amount of RIM is expected to be present in the southwest border between the Bridgeton North Quarry and OU-1. The dimensions and

justification for this statement would be helpful, as it appears unusual that a very small amount of RIM would be present given that the barium sulfate material was used as a routine operational daily cover at the OU-1 cell.

1. Section 3.6.2 (Page 10, 2nd bullet of 2nd paragraph) states an increase in the emission of radon as a result of an increase in gas permeability from soil moisture vaporization. The increase in gas permeability would also increase the advective radon flux. The radon emission estimate presented in Attachment A is based on RAECOM, which appears to only estimate the diffusive flux of radon. The impact resulting from an increase in the advective radon flux should also be estimated.

Specific Comments:

6. One of the core concerns in regards to the concentrations of radionuclides at the site relates to the fact that the wastes accepted at the landfill contained an elevated ratio of Th-230 to uranium and radium. The uranium ore processing residues were the result of a process that was designed to separate out uranium and radium thereby leaving thorium in the residue (Sections 2.0 and 5.4.2 of the 2008 ROD). Th-230 is the parent radionuclide for Ra-226. Th-230 was found on the surface in Area 1 at a maximum concentration of 57,000 pico Curies per gram (pCi/g), while the maximum surface concentration for Ra-226 was 910 pCi/g (Table 5-2 of the 2008 Record of Decision [ROD]). The 95% upper confidence limit (UCL) for Th-230 of the arithmetic mean on the surface was 8,140 pCi/g, while the 95% UCL of the arithmetic mean for Ra-226 on the surface was 581 pCi/g (Table 7-1 of the 2008 ROD). The 95% UCL for Th-230 of the arithmetic mean at all depths was 1,060 pCi/g, while the 95% UCL of the arithmetic mean for Ra-226 at all depths was 71.6 pCi/g (Table 7-1 of the 2008 ROD).

   In naturally occurring material Ra-226 and Th-230 will be in secular equilibrium with each other. However, the sampling results combined with the materials history indicate that Ra-226 and Th-230 are not in secular equilibrium at Area 1. Due to the relatively "short" half-life of Ra-226 (1,600 years) when compared with the much longer half-life of Th-230 (75,000 years), Ra-226 will effectively reach equilibrium with Th-230 in about 10,000 years. Because of this, it is important that when assessing the future risk and dose at the landfill the future concentration of Ra-226 should be considered and discussed.

   The ingrowth of Ra-226 from the decay of Th-230 was identified as a concern in Section 7.2.2 of the 2000 Remedial Investigation (RI), and a sample calculation is provided for the Ra-226 concentration in Area 2 after 1,000 years. Going from the 189 pCi/g value for the 95% UCL for the arithmetic mean for Area 2, to 871 pCi/g after 1,000 years. Additionally, in Table 7-4 of the ROD the future 95% UCL concentration for Ra-226 in the surface soil and all depths for Area 1 at 1,000 years are shown to be 3,224 pCi/g and 417 pCi/g respectively. Furthermore, Table 2 of the 2011 Supplemental Feasibility study (FS) shows a summary of the Th-230 decay and Ra-226 ingrowth for Area 2. As can be seen on this table, the peak Ra-226 concentration occurs at around 10,000 years. This is further demonstrated in Figure 15 of the FS. In Appendix F of the Supplemental FS, the cover thickness calculations are verified by use of the same RAECOM web calculator referenced in Attachment A of the Isolation Barrier Alternatives Analysis document. Appendix F of the Supplemental FS uses the Ra-226

concentration at 1,000 years for the 95% UCL of all the data for Area 1 (which can also be found in in Table 7-4 of the ROD) when providing the input for the RAECOM calculator. One could argue that since the Ra-226 concentration will peak and be closer to the current Th-230 concentration in 10,000 years, the 10,000 year concentration should be used. However, radiological risk assessments are generally carried out to 1,000 years.

In all of the scenarios provided in Attachment A of the Isolation Barrier Alternatives Analysis document, the 95% UCL of the arithmetic mean for Ra-226 at all depths of 71.6 pCi/g for Area 1 (from the 2000 RI) was used without consideration of the ingrowth of Ra-226 due to the decay of Th-230. While it may be useful to consider current conditions, future concentrations of Ra-226 due to the decay of Th-230 should be taken into consideration.

7. RIM was identified within 6 inches of the surface of Area 1 during the RI. The most elevated sample was identified on the surface. While the area identified with RIM present on the surface is smaller than that of the subsurface, any overburden thickness would be difficult to assess and in some portions of the site it is known to be zero. Attachment A assumes that an overburden exists across the site at 30 centimeters when performing the RAECOM calculations. However, when performing the calculations for the ROD selected remedy in Attachment A there is no overburden barrier assumed between the RIM and the remedy layers. The calculations for the cover thickness in Appendix F of the Supplemental FS do not calculate baseline conditions but rather mimic the ROD selected remedy calculation in Attachment A. In Appendix F of the Supplemental FS there is no assumed overburden between the RIM and the remedy. Calculation of the 95% UCL at all depths appears to include the surface sample results and is the basis of the RAECOM calculations. Section 2.2.2 of the 2011 Supplemental FS states the following:

   "Radionuclides are present in surface soil (0-6 inches in depth) over approximately 50,700 square feet (1.16 acres) of Area 1. Approximately 194,000 square feet (4.45 acres) of Area 1 have radionuclides present in the subsurface at depths ranging up to 7 feet, with localized intervals present to depths of 15 feet."

   Please provide an explanation as to why an overburden soil was assumed to be present for the baseline scenario and why it was assumed to be 30 centimeters.

8. In section 2.2 of Attachment A the calculated radon flux from the current configuration of Area 1 is compared to the average measured value during the 2000 RI. It should be noted that while the average Radon Flux sample resulted in 13 picocuries per meter squared per second (pCi/m2/s), 24 samples were collected and the three highest values were 245.9 pCi/m2/s, 22.3 pCi/m2/s and one was 8 pCi/m2/s. The remainder were all below 1.9 pCi/m2/s. The mode of the data is 0.2 pCi/m2/s and the median is 0.4 pCi/m2/s. With the 245.9 pCi/m2/s value removed the average becomes 2 pCi/m2/s. Therefor the 13 pCi/m2/s average of the measured data does not compare well with the remainder of the measured data and warrants clarification.

9. Ra-226 is a naturally occurring isotope found in varying concentrations throughout the world. The background soil concentrations determined in the RI are around 1 pCi/g. The RAECOM calculations in Appendix F of the FS assumed that each remedy layer would consist of material that contained 1 pCi/g. Background concentrations of Ra-226 in soil can

easily range between 0.5 and 3 pCi/g. It would be difficult to find soils that don't contain Ra-226. However, the RAECOM calculations included in Attachment A all assume the overburden, as well as the remedy layers, contain 0 pCi/g. Please provide an explanation for assuming the overburden and remedy layers contain no Ra-226 activity.

10. In the Isolation Barrier Alternatives Analysis document, one of the disadvantages of some of the more intrusive alternatives is testing for thorium, requiring a 24-hour sample turnaround period. Depending on how plans are developed, standard Ra-226 analysis for soil has a 21-day turnaround (due to the in-growth of Bi-214) that could further complicate these alternatives and merits acknowledgement.

11. Another consideration for alternatives that require excavation into the RIM is that radiologically-impacted fugitive dust has the possibility of being generated and additional controls to mitigate this would need to be implemented. This would have an impact on cost, schedule and provide a potential risk to site workers and merits acknowledgement.

Reference:

Engineering Management Support, Inc. (2000). Remedial Investigation Report – West Lake Landfill Operable Unit 1. Prepared for West Lake OU-1 Respondents Group, 10 April 2000.

U.S. EPA (2008). Record of Decision, Prepared by USEPA Region 7, 29 May 2008